

If we consider the work done, the number of first-class investigations, and the importance of the deductions made from them, we have no reason to be ashamed of our country's contribution to the general advance. We can be proud that so many students have proved their worth in the Cavendish and left it to fill important positions elsewhere, proud, too, that students from abroad have so freely acknowledged their debt to its spirit of enthusiasm and generous comradeship in research. It is true that the book leads us to consider the general question of physical research in England, and that we then find conditions which are not completely satisfactory. We have still to fight for the recognition of the value of such research, and we must in some way improve on the disjointed nature of the career of the research student. Too often his only reward is a teacher's position in which he finds difficulty in exercising the powers he has educated. But we cannot enter on the consideration of such questions now; we are only concerned with a book which fulfils admirably the purpose for which it was written.

A NEW BOOK ON REPTILES.

Reptiles of the World. Tortoises and Turtles, Crocodilians, Lizards, and Snakes of the Eastern and Western Hemispheres. By R. L. Ditmars. Pp. xix+373+87 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1910.) Price 20s. net.

PRIMARILY intended as a general survey of the reptiles of the world treated in a popular manner, the handsome volume which has just appeared simultaneously in this country and in America, will prove of special value to all who keep these animals in captivity. The name of Mr. Ditmars is a guarantee of accuracy and originality in the treatment of a subject in which he excels over all others. The success with which he has managed for some years the largest collection of living reptiles in existence, viz., that in the New York Zoological Park, is well known. From early boyhood his enthusiasm for reptiles, especially snakes, has led him to study the habits of these reptiles, so repulsive to many, even among educated people, and his house has always been the headquarters of an extensive collection of snakes, large and small, innocuous and venomous.

The information he gives us is therefore thoroughly trustworthy, unlike what we find in so many so-called popular works, and we strongly recommend this book to amateurs who keep reptiles in captivity, as well as to those whose duty it is to look after them in public menageries.

The American species, of course, receive the lion's share in a treatise emanating from America, and in a publisher's note to this English edition the reader is asked to bear in mind that the species referred to by the author as musk turtles, mud turtles, pond turtles, box turtles, &c., are known in this country as tortoises, the term turtle being restricted to the marine, and sometimes a few of the larger river species. The reviewer would express the regret that the term Terrapin, used for some of the fresh- or brackish-water tortoises in America, has not been made to include

these intermediate forms, which are neither true tortoises nor turtles. Further, the name sand lizard, applied to *Acanthodactylus boskianus* (p. 38) is misleading, as by sand lizard every English reader would understand our *Lacerta agilis*, which has always been known under that name. As is to be expected from an author who is not exactly a systematist—some may say all the better for the treatment of the subject in a popular style, the information as to the relationships and distribution of the animals dealt with, and the number of species in each genus, is not always quite up to date. Thus we notice that among the Chelonians the Carettochelydidae are still included among the Pleurodirans, to which they were tentatively assigned before the skeleton was known, although it is now established that they belong to the Cryptodirans, in the neighbourhood of the Trionychidae. The common snapping turtle is said to extend southward to Ecuador, whence it was first reported by the late Prof. Peters; but the reviewer was able to show, many years ago, that the snapping turtle of Ecuador is a distinct species, identical with the Central American *Chelydra rossignoni*. No allusion is made to the allied genus discovered a short time ago in New Guinea.

On the whole the author has adhered to the classification and nomenclature used in the British Museum catalogues (1885-96), but he has departed from the latter in the case of many North American types, which causes some confusion and a lack of harmony in the systematic treatment of the subject.

These are, however, very trivial defects. The great value of the work lies, as we have said, in the matter relating to the habits of the reptiles, both wild and in captivity, a subject on which the author is *facile princeps*.

The varied contrivances by which reptiles secure their food, produce and rear their young, harmonise with their surroundings, &c., are fully dealt with, and in a thoroughly original manner. The size to which the largest crocodiles and snakes grow is also discussed, and only trustworthy records are adduced. The largest crocodile measures 30 feet, so does the largest python, the anaconda rather more than 25, the *Boa constrictor* only 11; but it must be borne in mind that the name *Boa constrictor* is often applied to pythons in menageries and by colonists in Africa.

On the subject of snakes swallowing their young, it is important to have the opinion of an observer of such wide experience as Mr. Ditmars. "The story of the female snake swallowing her young in time of danger," he says, "is purely fallacious. It has originated from observations of cannibal species making a meal of young reptiles" (p. 203). Apropos of cannibal species, we wish to direct attention to the important experiments made on the king snake (*Coronella* or *Ophibolus getulus*) of North America, a harmless species, which is apparently immune to the venom of such deadly pit-vipers as the rattlesnake, the copperhead, the mocassin, and the South American Lachesis, whilst it usually dies within an hour if injected with the poison of the old-world cobras.

Mr. Ditmars's observations and experiments on chameleons and other lizards with changing hues have

convinced him that the colour-changes which these reptiles undergo with such rapidity are not, as often believed, in harmony with their surroundings, but are regulated chiefly by light, temperature, excitement, fright, or health. We here reproduce a partial list of these experiments on the common chameleon:—

Specimen A. Placed in the sunlight so that but one side of the lizard was exposed to the rays.

Specimen B. Placed in the sunlight at an angle to entirely suffuse the reptile with the rays.

Specimen C. Placed in a dark box; temperature, 73° F.

Specimen D. Placed in a dark box; temperature, 50° F.

After fifteen minutes, the following results were noted:—

Specimen A. Was a dark brown on the side that had been exposed to the sun; the shadowed side was a pale brown, mottled with green.

Specimen B. A uniform brown, deeper than the dark side of specimen A.

Specimen C. When the cover of the box was drawn the lizard emerged in a brilliant coat of green.

Specimen D. Crawled sluggishly from the cold quarters. Its colour was a uniform slaty-grey.

One curious effect of sunlight and shadow was noticed. A specimen had been basking under a coarse wire grating. Becoming frightened at the approach of the observer, it changed its position. On the dark brown body was what had been the shadow of the grating, brilliantly imprinted in pale yellow. Within half a minute this pattern had entirely faded.

The book is copiously illustrated with reproductions of photographs taken by the author from living specimens, and most of them are of high excellence. In some cases, however, the reduction is too great, such figures as those of the European lizards and the glass-snakes and slow-worm (plates xxxia and xxxvii.) being, from this cause, practically useless. The snake figured on plate lxxvii as *Cerastes vipera*, and stated to measure about two and a half feet, is a hornless *Cerastes cornutus*. The author appears to be unaware of the existence of such hornless specimens, otherwise he would not have written (p. 328) that it is "impossible to mistake the horned viper," and that *C. vipera* is, but for the absence of horns, much like *C. cornutus*. A three-colour process figure of the rhinoceros viper, "the most beautifully coloured of all poisonous snakes," is given as a frontispiece.

G. A. B.

THE CALCULUS OF VARIATIONS.

Leçons sur le Calcul des Variations. By Prof. J. Hadamard. Tome premier. Pp. viii + 520. (Paris: A. Hermann et Fils, 1910.) Price 18 francs.

NO one could be more competent than M. Hadamard to deal with the calculus of variations, and when this work is completed it will be a most valuable exposition of the present state of the subject. It is significant that in the first lines of his preface the author expresses the view that the calculus of variations is only a first chapter of the functional calculus (*calcul fonctionnel*) of Volterra, Pincherle, &c., and he gives, in fact, a short chapter on this new theory (pp. 281–312). But the analysis, in this volume, is mostly of a more familiar kind.

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In fact, the first step in any actual case that naturally presents itself is still the classical one of Lagrange, by which we obtain a differential equation, or a set of differential equations. For simplicity, suppose the varied integral to be $\int f(x, y, y') dx$, then the differential equation is of the second order, and its solution is said to form a family of extremals. Supposing that the limiting values of x and the corresponding values of y to be given, then in the general case we may expect to find one extremal satisfying the terminal conditions. But it by no means follows that this curve really makes the given integral a maximum or minimum; an example due to Scheeffer is given on p. 45, which brings out the point very clearly. In this case the extremal found from the differential equation is $y=0$, and the corresponding value of the integral is 0; nevertheless, analytical curves can be drawn, as close as we please to $y=0$, which make the integral negative.

In any case, a solution obtained from an extremal is only a relative one; that is, the extremal gives a maximum or minimum value of the integral relatively to adjacent paths. And here it is important to define what we mean by *adjacent*, a fact first fully realised by Weierstrass, whose definition of adjacency of the p th order is given on p. 49. We may have, for instance, two curves each passing through the terminal points A, B, and as close together as we please, but one may be of continuous, the other of discontinuous curvature. Now, if we have a varied integral involving higher differential coefficients than y' , we must exclude curves of discontinuous curvature, otherwise the problem becomes meaningless, and similarly in other cases.

After the limitations of the problem have thus been touched upon, book ii. deals with the first variation, and the conditions of the first order, including variable limits. Among other interesting points we have Weierstrass's transformation to homogeneous coordinates, a discussion of foci (points on the envelope of a family of extremals), and two very useful innovations due to M. Hadamard. If $\int f(x, y, y') dx$ is the varied integral, the *figurative* is defined to be the curve $f(x, y, y')=u$, in which u, y' are regarded as current coordinates, and x, y as constants. The *figuratix* is defined as the polar reciprocal of the figurative with respect to $x^2+y^2=1$. By means of these curves the author is able to put various analytical conditions into a vivid geometrical shape. It may be added that book ii. contains the discussion of various classical problems, such as brachistochrones, least action, the Hamiltonian equations of dynamics, &c.

Book iii. introduces the second variation, and goes more deeply into the methods of Weierstrass, as well as those of Jacobi, Clebsch, Hilbert, Kneser, and others. We arrive ultimately at a statement, in various forms, of sufficient conditions for a minimum (pp. 389, 397), deduced mainly from the properties of a pencil of extremals, and a brief discussion of the necessary conditions, illustrated by examples (chapter iii.). The remaining chapters deal with variable limits, discontinuous solutions, Osgood's theorem in